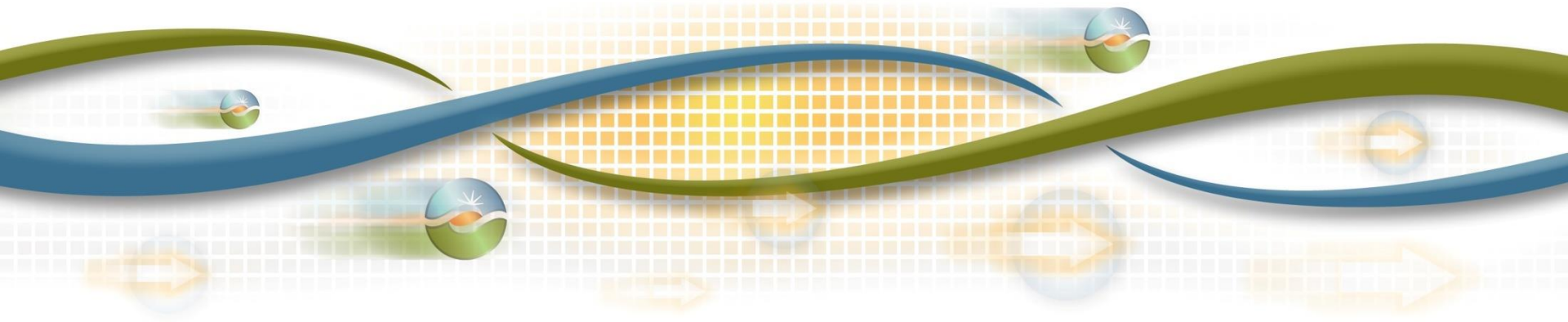




## Joint Agency Workshop Microgrid Roadmap

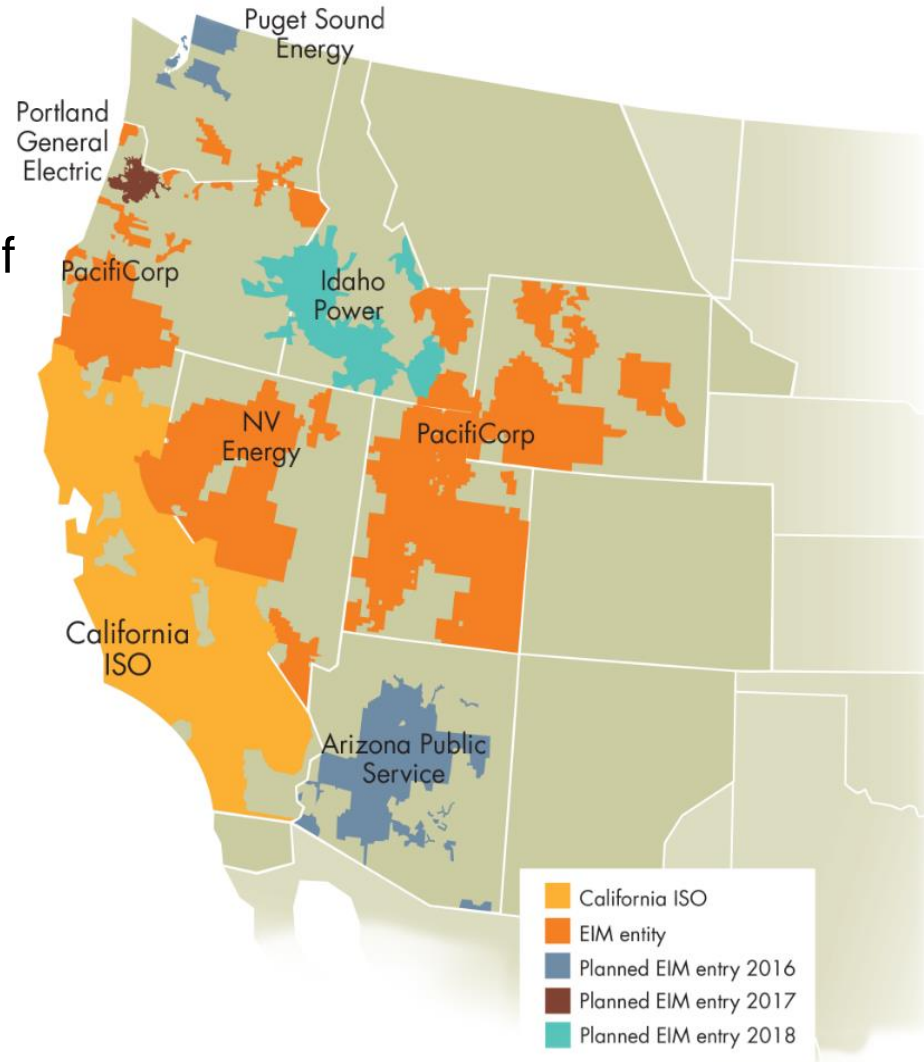
Peter Klauer, Smart Grid Solutions Manager  
California ISO

September 6, 2016



# California ISO

- Nonprofit public benefit corporation
- Part of Western Electricity Coordinating Council: 14 states, British Columbia, Alberta and parts of Mexico
- 71,000 MW of power plant capacity
- 50,270 MW record peak demand (July 24, 2006)
- 26,014 circuit-miles of transmission lines
- ISO is governed by the Federal Energy Regulatory Commission, which has jurisdiction over transmission lines that cross state borders.



# California energy and environmental policies drive renewable integration and transmission needs

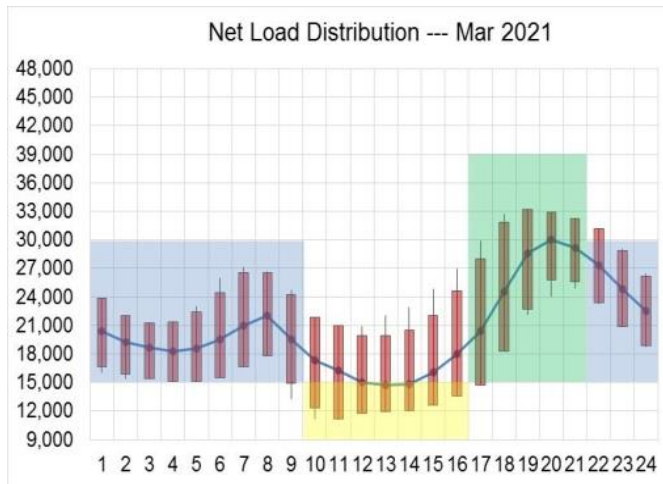
- Greenhouse gas reductions to 1990 levels by 2020
- 33% of load served by renewable generation by 2020
- 12,000 MW of distributed generation by 2020
- 1,325 MW of Grid Storage deployed by 2024
- Ban on use of once-through cooling in coastal power plants
- Less predictable load patterns – rooftop solar, electric vehicles, energy efficiency, and smart grid technologies

# California energy and environmental policies drive renewable integration and transmission needs

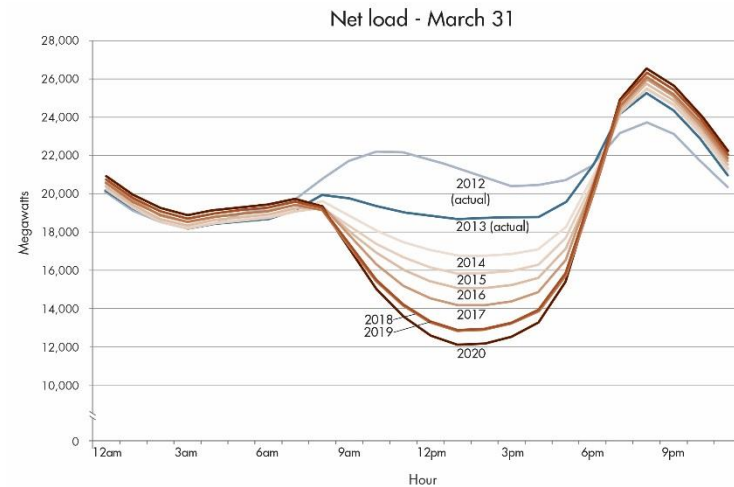
- Governor Brown's 2030 goals
  - 50% renewables
  - 50% reduction petroleum use – cars & trucks
  - Double energy efficiency of existing buildings
  - Greenhouse gas reductions to 40% below 1990 levels

# ISO Operational Challenges at 50% RPS

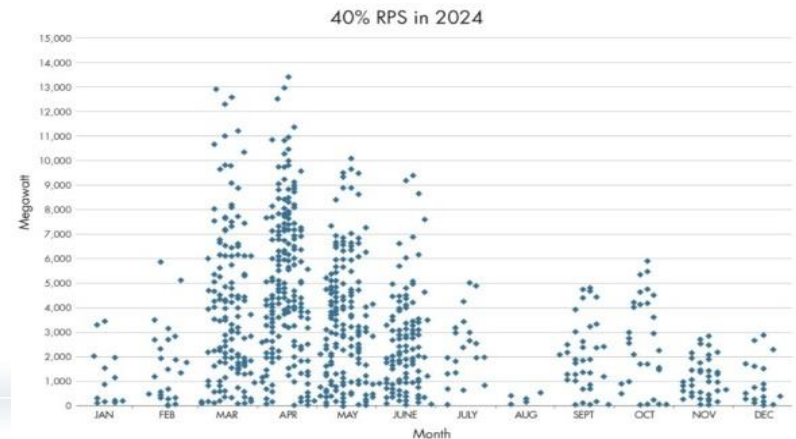
- Over supply and ramping challenges



- Time of use alignment with grid conditions



- Potential for renewable curtailment



# Flexible Resources for Grid Reliability

## Flexible Resources can:

- Respond quickly and accurately
- Change ramp directions quickly
- Sustain upward or downward ramp
- Start and stop multiple times a day
- Respond for defined periods of time
- Start with short notice from a zero or low-electricity operating level
- Accurately forecast operating capability



**Microgrids are** comprised of localized load and generation resources which *normally operate connected to and synchronous with the traditional centralized grid* but can disconnect and function autonomously as an island within the macrogrid



Source: DOE

# Microgrid Services to the ISO Controlled Grid

- Microgrids, like other wholesale grid resources can serve as:
  - A dispatchable energy resource
  - An ancillary service resource
  - A load curtailment resource
  - A load increase resource

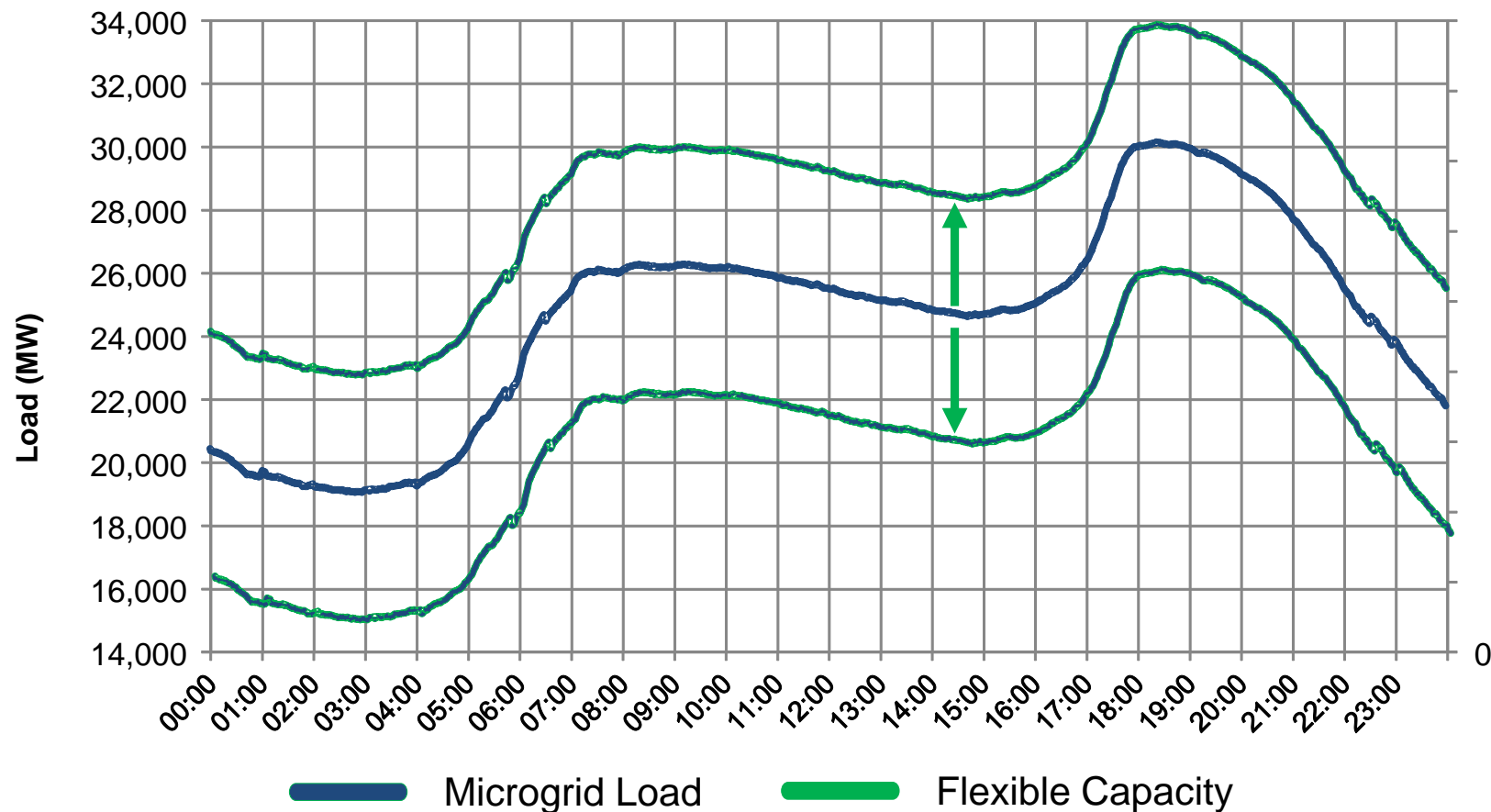


# Characteristics of a participating microgrid

- A collection of loads and DERs that meet the needs of the microgrid as well as provide services beyond the microgrid
- A portion of the microgrid is modeled as a flexible wholesale resource
- The grid operator visibility is at the microgrid resource level
- Microgrid controllers deliver grid services based on the collective action of the individual sub-resources within the microgrid
- Microgrids exhibit reliable disconnect and reconnect procedures

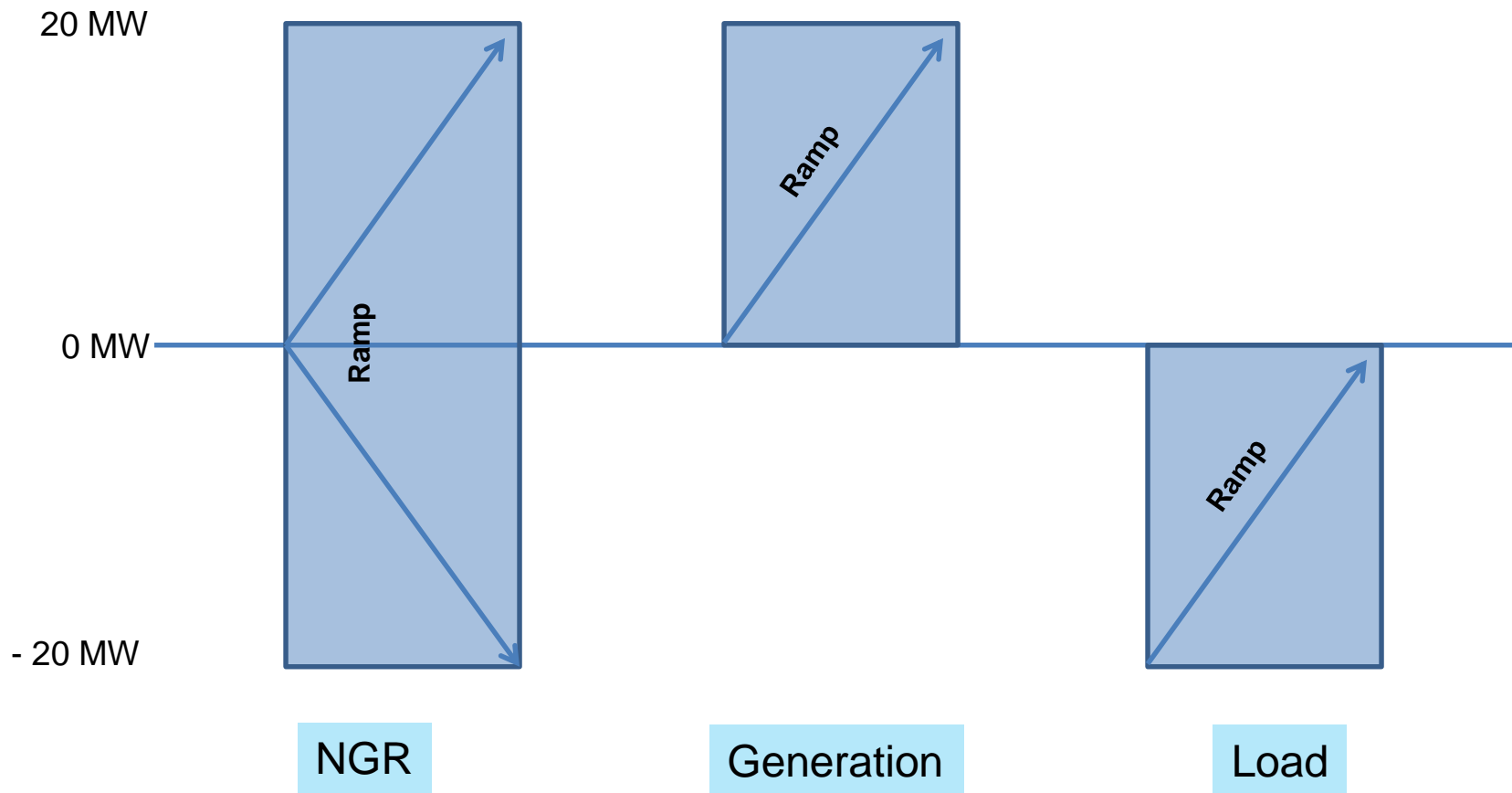
# Microgrid Modeling and Performance

## Microgrid Resource Load Profile



Slide 15

In 2012, the ISO implemented non-generator resource (NGR) functionality within the wholesale markets

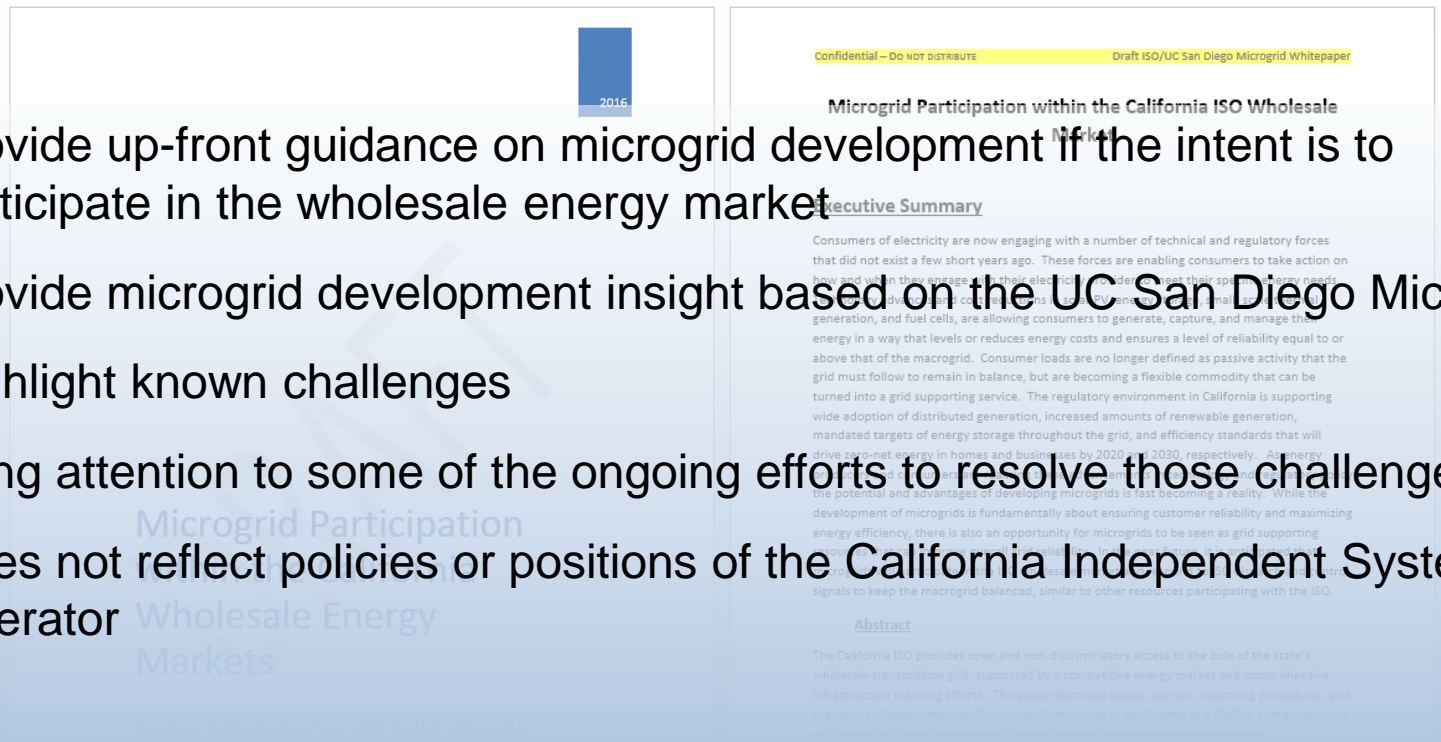


# Microgrid Control System Requirements

- Microgrid control systems must support existing and future wholesale participation and performance requirements
  - Visibility and Control
  - Performance Measurement
  - Minimum Capacity
  - Continuous energy output
  - Response time
  - Frequency and Voltage support

# Joint White Paper on Microgrid Development and Wholesale Energy Market Participation

- Provide up-front guidance on microgrid development if the intent is to participate in the wholesale energy market
- Provide microgrid development insight based on the UC San Diego Microgrid
- Highlight known challenges
- Bring attention to some of the ongoing efforts to resolve those challenges
- Does not reflect policies or positions of the California Independent System Operator



# Paper is broken into 2 parts

- Part 1: Microgrid implementation for ISO market participation
  - Interconnection and Planning
  - Network Modeling and Resource Implementation
  - Resource Characterization and Modeling
  - Telemetry and Metering Requirements
  - Resource Availability and Outage Management
  - Market Participation and Bidding
  - Wholesale Energy Market Settlements



# Paper is broken into 2 parts

- Part 2: Microgrid development case study (UC San Diego)
  - UC San Diego Microgrid background
  - Simulation of Market Participation by the UCSD Microgrid
  - Interconnection and Communication Requirements
  - Barriers of Adoption from a Microgrid Developer Perspective

# The ISO is preparing the way for microgrid and other flexible resources

- Providing a flexible market resource model that optimizes a resource that continuously operates across negative and positive ranges
- Supporting interconnection processes for both transmission and distribution level microgrids
- Facilitating aggregated DER resource participation

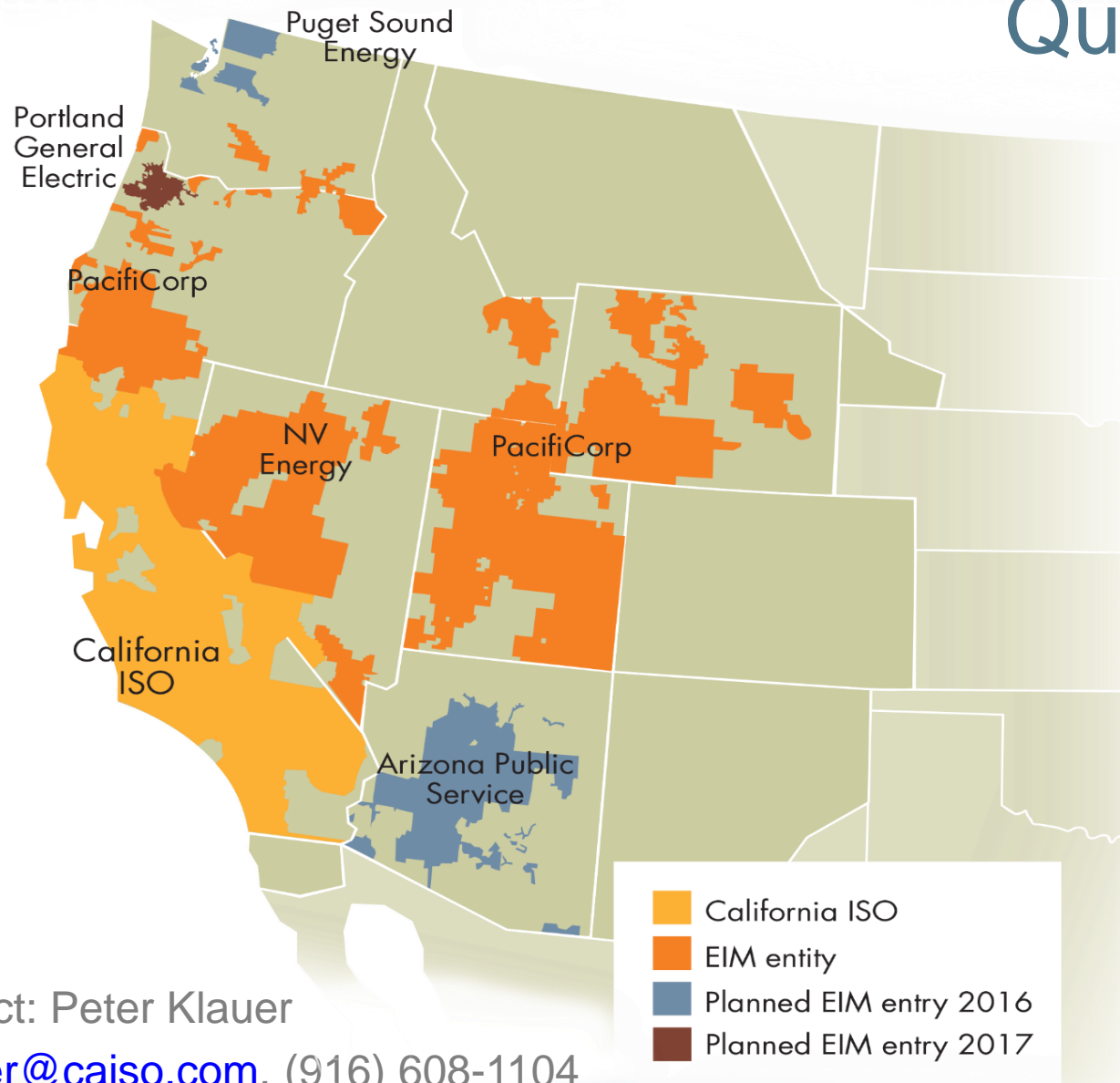
# ISO Stakeholder Initiatives that have direct impact on the integration of microgrid resources

- Energy Storage and Distributed Energy Resources
  - [http://www.caiso.com/informed/Pages/StakeholderProcesses/EnergyStorage\\_AggregatedDistributedEnergyResources.aspx](http://www.caiso.com/informed/Pages/StakeholderProcesses/EnergyStorage_AggregatedDistributedEnergyResources.aspx)
- Frequency Response
  - <http://www.caiso.com/informed/Pages/StakeholderProcesses/FrequencyResponse.aspx>
- Metering Rules Enhancements
  - <http://www.caiso.com/informed/Pages/StakeholderProcesses/MeteringRulesEnhancements.aspx>
- Expanding Metering and Telemetry Options
  - <http://www.caiso.com/informed/Pages/StakeholderProcesses/ExpandingMetering-TelemetryOptions.aspx>

# Areas for continued discussion and development

- Defining distribution and transmission level grid services that microgrids are able to provision
- Interconnection requirements of microgrid entities
- Load forecasting and load serving obligations
- Allocation of cost for grid reliability services (voltage/frequency)
- Inverter and microgrid control capabilities that support advanced ancillary services from resource aggregations
- Visibility, control, and measurement requirements of microgrids
- Islanding and reconnection capabilities and procedures

# Questions?



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